Small Business Innovation Research/Small Business Tech Transfer

Aircraft Chemical Sensor Arrays for Onboard Engine and Bleed Air Monitoring, Phase II

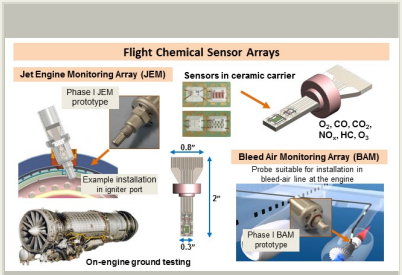
Completed Technology Project (2017 - 2021)

Project Introduction

Makel Engineering Inc. (MEI) is developing flight capable chemical microsensor arrays for in situ monitoring of high temperature bleed air and turbine exhaust in jet engines. The proposed chemical sensor probes will be a new class of onboard engine instrumentation for real time monitoring engine and bleed air system operation in flight. Sensor arrays developed by MEI have been demonstrated for ground tests to quantify composition of critical constituents in turbine engine exhaust products, including CO, CO2, NOx, O2, and HC (unburned hydrocarbons). There currently is no flight capable instrumentation for real time measurement of high temperature gas streams from engine bleed air or the turbine exhaust. Ground test demonstrations with high temperature capable (500 to 600oC) solid-state chemical microsensors have shown the potential value for engine health monitoring and detection of engine faults or abnormal operations from ingestion of high moisture levels or particulate from volcanic emissions. The development of flight qualified engine sensors that can measure key chemical species will enable a new level of aeronautical vehicle health management. Phase I of the program demonstrated approaches in sensor miniaturization and robust probe design that enables placement of multiple species in a compact single port. Phase II will develop the next generation prototypes targeting specific engine and bleed air systems for demonstration, validating design choices and proving system performance in a realistic environment for each application.

Anticipated Benefits

This proposal targets the improvement of NASA?s ground and flight test aeronautics testing capabilities. Potential end users within NASA include ground test facilities such as Western Aeronautical Test Range (WATR) and Flight Loads Laboratory (FLL), as well as flight facilities such as AFRC with both piloted and unmanned systems. Real-time, in-flight data regarding combustor condition and emissions species can provide a previously unavailable test capability for NASA. Monitoring of bleed air for contaminants and fuel backflow is also an area of interest.The air delivered to the cabin of a passenger aircraft is commonly bled from the compressor section of the aircraft?s engines, and conditioned before supplied to the cabin. Under normal conditions, this bleed air is clean and suitable for breathing. However, the bleed air may be contaminated by exhaust ingestion, lubricant leaks, or other potential faults in the system. Aircrew and frequent fliers are exposed to cabin air repeatedly and for extended periods of time, increasing the changes of exposure to contamination events. Recent air contamination events resulted in the emergency landing of a commercial flight. There is currently increased interest from commercial passenger aircraft manufacturers and operators to incorporate sensors to monitoring bleed air quality to avoid exposure of harmful or noxious gases to passengers and crew. MEI is currently in discussions with The Boeing Company looking at sensor approaches for bleed air monitoring. MEI has also been working with Cobham Mission System (CMS)



Aircraft Chemical Sensor Arrays for Onboard Engine and Bleed Air Monitoring, Phase II Briefing Chart Image

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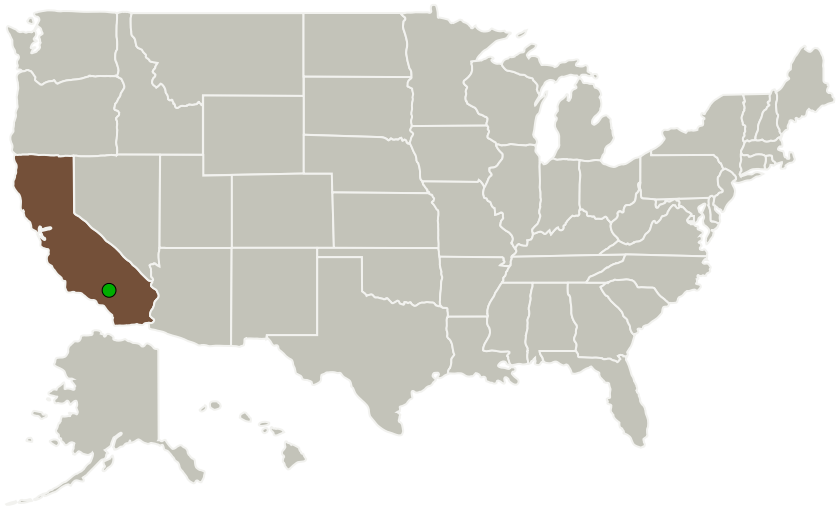
on pilot breathing air quality monitoring for the Air Force for aircraft which use On-board Oxygen Generation System (OBOGS) to supply pilot breathing air.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Makel Engineering, Inc.	Lead Organization	Industry Small Disadvantaged Business (SDB)	Chico, California
Armstrong Flight Research Center(AFRC)	Supporting Organization	NASA Center	Edwards, California

Primary U.S. Work Locations
California

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Makel Engineering, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Managers:

Paul M Dees
Bruce R Cogan

Principal Investigator:

Susana Carranza

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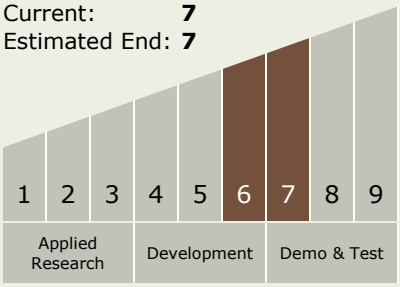
Images

Briefing Chart Image
Aircraft Chemical Sensor Arrays for Onboard Engine and Bleed Air Monitoring, Phase II Briefing Chart Image
(https://techport.nasa.gov/image/136819)

Technology Maturity (TRL)

Start: **6**
Current: **7**
Estimated End: **7**



Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System